PREVENTING CRIMINALITY: AN ECONOMIC EVALUATION OF A BRAZILIAN PROGRAM

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ABSTRACT

In this work we carried out an economic evaluation of *Fica Vivo* program in its pilot area, Morro das Pedras slum. *Fica Vivo* is the main program of prevention and control of criminality that is being carried in Brazil. This program was based on the CeaseFire Project proposed by the School of Public Health of the University of Illinois - Chicago in the nineties and that inspired several programs in other countries. The principal objective of the program is the reduction of homicides in areas of hot spots. Regarding homicides, in general, in Brazil, these hot spots occur in slums. The program combines preventive with repressive (police/ judicial) activities. This evaluation is done considering the pilot area of the program, *Morro das Pedras* slum, situated in Belo Horizonte city, Brazil. The impact of the program is estimated using a Double Difference Matching method applied to a panel data of police records between 2000 and 2006. The impact variable is the half-yearly homicide rate per one hundred thousand inhabitants. The costs were accounted based on accountability information sourced by the Social Defense Secretary and the State Police. The results show that the program reduces criminality, diminishing the homicide rate.

Keywords: Economic Evaluation; Criminality Prevention, Fica Vivo Program,

1. INTRODUCTION

One recurring fact in the criminology literature is the spatial concentration of crime. One of the first works to deal with this theme is Shaw and Mckay (1942). The authors investigated the characteristics of areas presenting high crime rates in the United States. The recognition of the spatial concentration of crime culminated in several studies focused on areas of high criminality, denominated "hot spots" (Pierce *et al*., 1988; Sherman *et al*., 1989, Weisburd *et al*., 1992). These studies inspired the creation of programs or policies of prevention and control of criminality specific to hot spots or to young people who lived in

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these places. Examples are the CeaseFire Project in Boston and the Zero Tolerance policy in the subways of New York.

In criminology, there are various works that analyze the effect of prevention programs for criminality. The majority of them, however, concern programs focusing on young and adult criminals or interventions focused on poor children and young individuals (Greenwood *et al.*, 1998; Aos *et al*., 2001; Welsh and Farrington, 2007). Few works evaluate interventions based on hot spots by means of experimental or *quasi* experimental impact evaluation methodologies (Braga 2001; Braga, 2007). Specifically in economics, the literature on the impact evaluation of programs of prevention and control of criminality is quite scanty, principally in relation to interventions focused on hot spots (Ihlanfeldt, 2007; Ludwing *et al*., 2001; Katz *et al*., 2001; Machin and Marie, 2005; Sabates and Feinstein, 2008). In part this lack of works is due to inadequate database and the difficulties in implementing identification strategies that allow causality relations to be addressed. Cost-benefit or cost-effectiveness analyses of social programs aimed at reducing violence or criminality are much less frequent in economic literature.

The objective of this paper is to carry out an economic evaluation of a Brazilian program designed for the prevention and control of criminality, denominated *Fica Vivo*. This evaluation focus on the pilot area called *Morro das Pedras* slum. *Fica Vivo* is based on CeaseFire Project proposed by the School of Public Health of the University of Illinois - Chicago in the nineties and that inspired several programs in other countries (Braga *et al*., 2001; Rosenfeld *et al*., 2005; Papachristos *et al*., 2005; Skogan *et al*., 2008). The theoretical approach of CeaseFire is based on social disorganization theory. It develops activities at the community aiming to change individuals´ behavior in order to reduce the incidence of homicide. In the United States, the project was initially set up in Boston and later extended to other cities such as Baltimore, Newark, Irvington, Kansas City, Los Angeles, Las Vegas, and Pittsburgh. Cease Fire program has already been evaluated and the results seems to be positive. Phiel *et al.* (2000) showed that the Operation Ceasefire was associated with a large reduction in Boston youth homicides.

Fica Vivo strives for the reduction of homicides in areas where its incidence is high, in general, slums, combining preventive and repressive activities. Preventive activities focus on social support offered, principally to young people. The repressive actions aim at providing a rapid response of the police and judicial system, increasing the probability of arrest and punishment[1].

In this article we investigate program´s costs using accounting records of all the expenses made under the program by the State Secretariat for Social Defense (SEDS). We also consider information on the police involved directly with the program. This information was made available by the Military Police of Minas Gerais (PMMG).
A Double Difference Matching (DDM) model is implemented to estimate the impact of the program using a georeferenced longitudinal database from police records. The work

[1] *Fica Vivo* has distinguished itself in Brazil and abroad having been cited as a model of good practice in the portal of the United Nations Office against Drugs and Crime (UNODC) http://www.unodc.org/brazil/pt/best_practices_fica_vivo.html, in the portal *Children in Organized Armed Violence* (COAV)

http://www.coav.org.br/publique/cgi/cgilua.exe/sys/start.htm?infoid=1502&sid=26&UserActiveTemplate=_es and in various other local and international media.

benefits from the existence of a longitudinal administrative database that permits to follow up homicides rates in both treated and non treated areas before and after intervention. This work contributes to the empirical literature on the evaluation of programs of prevention and control of criminality supplying evidence of a program in Latin America where high levels of violence are found. In addition, the evaluation method uses administrative data from police records which makes it possible its replication in other countries.

The principal results indicate that the cost of a homicide avoided by *Fica Vivo* varies between approximately 93 and 112 thousand dollars in accordance with the method of apportionment[2]. The rate of return of the program is favorable for practically all parameters utilized in sensitive analysis, varying from a small return tax, 4%, to a large return tax, 840%. These results suggest that the *Fica Vivo* present a favorable cost-benefit ratio. The article is organized in six more sections in addition to this introduction. In the second and third sections we describe briefly the program and present the data bases utilized. In sections four and five we investigate the effectiveness and the costs of implementation. Subsequently we carry out the cost-effectiveness and cost-benefit analysis. Finally we present our final considerations.

2. DESCRIPTION OF THE *FICA VIVO* PROGRAM

2.1 DESIGN OF THE PROGRAM

The *Fica Vivo* program was developed in the Centre of Studies in Criminality and Public Security of the Federal University of *Minas Gerais* - CRISP/UFMG - which defined the intervention methodology for its implementation in the pilot area that occurred in 2002. In May of 2003 the program was institutionalized by the Government of the State of Minas Gerais, becoming under responsibility of the State Secretary of Social Defense.

Fica Vivo approach is the theories of social disorganization and routine activities. Its design has been inspired by highly successful international experiences, principally the *CeaseFire* program which was set up in Boston. It is focused on groups that have a greater vulnerability to crime activities and seeks to change social and institutional conditions that may influence criminal activity.

The program combines both policies and social protection actions. Policies actions are carried out by means of repressive and community policing. The police acts mainly on drug selling points and on the seizure of weapons. It acts in cooperation of the judiciary in order to guarantee the fast judgment and sentencing for the criminals. The community policing uses a special patrol group created for risky areas (GEPAR). GEPAR carries out routine and systematic activities aiming to alter the community's negative perception of the police also establishing cooperation between the community and the police.

Social protection actions are coordinated by SEDS and involve institutions' representatives including: state and municipal public agencies, federal university, non-governmental organizations - NGOs, and private organizations. The activities undertaken are focused on young individuals, consisting basically of social support actions (education, health, sport,

[2] All currency values converted at the 2006 average exchange rate real/dollar (US$ 1= R$ 2,1753).

leisure, culture and professional training projects) and the constitution of protection networks.

The *Fica Vivo* program has been the object of evaluation of two other works. Andrade and Peixoto (2006) carry out an economic evaluation of nine prevention programs and control of criminality in Brazil, among them the *Fica Vivo*. The impact of the program is not calculated in the evaluation, they being considered equal to similar program abroad. Silveira (2007) undertakes a process assessment of *Fica Vivo* in the pilot area of *Morro das Pedras*.

2.2 DEFINITION OF TREATMENT AREAS

The definition of treatment areas was based on a spatial analysis of criminality in *Belo Horizonte* carried out by CRISP (CRISP, 2002). From this diagnosis it was identified a homicide concentration in 6 of the 81 slums in Belo Horizonte city. These slums were characterized by high rates of homicide associated with a high incidence of social vulnerability[3].

In August of 2002 *Fica Vivo* was set up in the pilot area, a slum called *Morro das Pedras*. This area was chosen because it was among the six areas identified in the diagnosis, the one that exhibited the largest homicide rate per one hundred thousand inhabitants associated to a high level of social vulnerability. These both criteria were the most relevant. This area had also a greater presence of local public organizations and private organizations focused on social protection (Silveira, 2007). This environment facilitated the implementation of the program.

In May of 2003 the program was institutionalized by the Government of the State of Minas Gerais, becoming under responsibility of the State Secretary of Social Defense. The government defined as eligibility criteria of the program both the homicide rate and social vulnerability index. The areas that received the program were all characterized as hot spots in the diagnosis conducted by CRISP (2002). A criminal hot spot is an area with high concentration of crime. Between 2004 and 2007 the program was extended to another nineteen violent areas of Minas Gerais State (Silveira, 2007). In this paper we analyze the pilot area of *Fica Vivo*, *Morro das Pedras* slum. In this area the program is more consolidated and has been set up longest.

3. EFFECTIVENESS OF *FICA VIVO*

3.1 DATA BASE

Two databases are used in this work in order to analyze program effectiveness. The georeferenced records of the Military Police of Minas Gerais (PMMG) for the period from January, 1 of 2000 till December, 31 of 2006; and data from the 2000 Demographic

[3] The social vulnerability indicator is built up from the following variables: type of housing construction ; average number of years of scholarship; illiteratecy; labor market insertion; infant mortality rate; urban infra-structure; number of social protection bodies; % of young people in the population; rate of pregnancy in adolescence (Silveira, 2007; Beato, 2005).

Census. The PMMG database contains information on criminal events taken from the Bulletins of Occurrence (BO)[4]. The BOs are official documents generated by the Military Police for the registration of all offences that come to its knowledge. For each occurrence there is information on the type of occurrence, place (latitude and longitude), exact time and date, and the waiting time between the police call and their arrival. In this paper we use only BO records of offenses classified as homicides that occurred in Belo Horizonte city[5]. In the PMMG database it is possible to obtain any spatial and temporal unit of analysis, as it contains all records of crimes committed in the municipality, registered through the latitude and longitude of the place of each event. In addition, the time and date of occurrence for each event is also recorded.

The 2000 demographic census contains information on the characteristics of the residents, of the households, and of head households, collected in 2000, by Brazilian Institute of Geography and Statistics (IBGE). This information is made available by census sector, weighting areas and the whole municipality[6].

SPATIAL UNIT

Usually, social programs evaluations are carried out by measuring the results considering individuals or households. In this work, the output variable is defined spatially. The most natural spatial unit of analysis would be the district or suburb, given that the program was implemented by slums. However, if we were to consider the suburb as the spatial unit, we would have only one unit treated. The option was to define as the spatial unit the census sector itself, which is the smallest spatial unit made available in the demographic census.

TEMPORAL UNIT

The census sector is a small spatial unit in which the majority presents a low number of homicides and population. These small numbers determine that a small variation in the number of homicides in the census sector translates into a large variation in the homicide rate per one hundred thousand inhabitants. Choosing a temporal unit of short duration, the homicide rate per one hundred thousand inhabitants would be very volatile. On the other hand, a temporal unit of long duration minimizes the problem of fluctuation, but loses in terms of sample variance. We tested four temporal units, monthly, quarterly, half-yearly and annually. The half-yearly unit proved to be the most suitable for the analysis. The final database is a panel composed of the 2,556 *Belo Horizonte* city's census sectors followed during 14 semesters from 2000 till 2006.[7]

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[4] This data base was georeferenced and made available by the Centre of Studies in Criminality and Public Security of the Federal University of Minas Gerais (CRISP/UFMG).

[5] Homicides records used are those classified by the Military Police of Minas Gerais as consummated homicide, BO 4002. Other types of crime were not analyzed because *Fica Vivo* program has as principal objective the control of homicides.

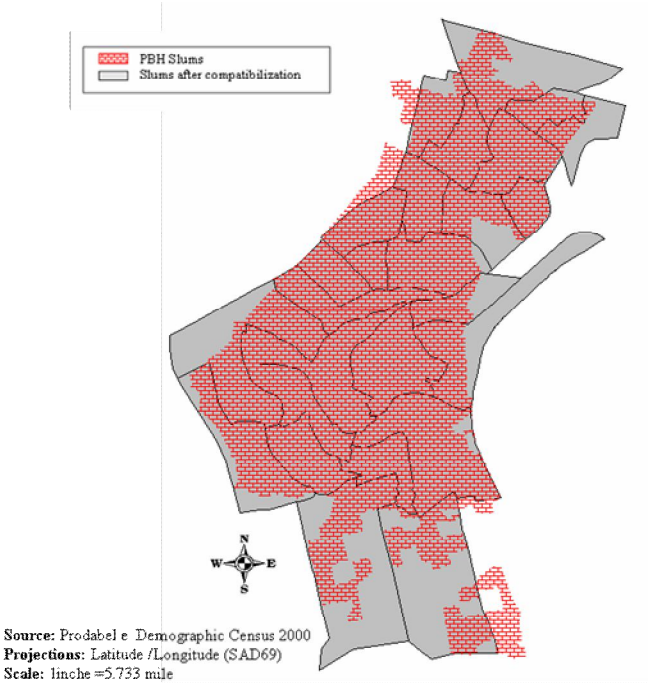
[6] Weighting areas, in portuguese, *areas de ponderação*. It refers to an aggregation of census sectors defined by Brazilian Institute of Geography that performs the Demographic Census (IBGE).

[7] For the analysis we excluded the census sectors belonging to the slums of Belo Horizonte that received the program and which will not be evaluated in this work.

3.1.2. DEFINITION OF THE TREATMENT AND COMPARISON GROUPS

The treatment group is comprised of the 27 census sectors that belong to the pilot area, the slum of *Morro das Pedras*. As can be observed in Figure 1, the outline boundaries defined by the *Belo Horizonte* Mayor's Office (PBH) do not agree with those of the census sectors, and for the most part divide them, that is, a part of the area of the same census sector belongs to the slum and the other does not. In order to harmonize the area of the slum defined by the PBH with the area of the census sectors we established that the census sector is treated if it is totally contained, or if most of its area is contained, in the area of the slum delimited by the Mayor's Office.

Figure 1
COMPATIBILIZATION OF SLUM AREA DEFINED BY PBH WITH THE CENSUS SECTORS AREA



The evaluation of the program is carried out considering the comparison group consisting of *Belo Horizonte* city's census sectors that did not receive the program. This group is selected by the methodology of Propensity Score Matching (PSM).

3.1.3. OUTPUT VARIABLE

To evaluate the program we used as output variable the homicide rate per one hundred thousand inhabitants per semester which permits standardization of the areas according to population size. We calculate this rate using the annual population projection undertaken by CEDEPLAR/UFMG for the weighting areas of *Belo Horizonte* city up to 2010[8]. As the output variable is defined for each semester, we calculated the population growth rate for each weighting area in each semester through linear interpolation. The half-yearly population growth rate by weighting area is used to estimate population growth rate for the census sectors contained in each weighting area assuming that census sectors´ population grows at the same rate as its respective weighting area.

3.2. EVALUATION METHODOLOGY

The principal difficulty to evaluate social programs' impact is due to the problem of omitted data, as we cannot observe the unit that receives the intervention in the two states (with and without intervention). If we possessed data in both states of nature, a way of measuring the impact of the program would be to estimate the average difference of the output variable in the two states. Random experiments, also called pure experiments, are those in which the units that receive the program are chosen randomly among the eligible units. The randomization of the treated and not treated samples allows for the impact estimation through the difference in the average results among treated and non-treated. This impact estimation can be realized as, under random experiments, we can assume that attributes before the intervention are independent of the treatment. However, in practice, it is almost impossible to carry out random experiments in the case of social programs. Normally, these programs have a non-random design and the evaluations utilize non-experimental designs (Angrist and Krueger, 1998). In this case, the non-treated cannot be considered directly counter-factual to the treated, because the attributes of both are not necessarily equivalent. The evaluation literature points out three types of bias which can occur in the differences found in the output variable between treatment and comparison groups: bias arising due to differences in observable characteristics between the two groups; absence of common support bias and selection bias that arises out of the differences in non-observable characteristics (Heckman *et al*., 1998).

In this paper we use a Double Difference Matching Model – DDM. This method combines Propensity Score Matching - PSM with Double Difference Method - DD (Ravallion, 2005). This method allows the bias to be quite reduced as PSM minimizes the biases regarding differences on observable attributes and absence of common support, while the DD reduces the selection bias.

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[8] This population projection was carried out in the project PBH 21st century. See: https://www.cedeplar.ufmg.br/pesquisas/projeto_pbh_sec._xxi.php .

This technique is quite conditioned on the identification strategy. In this sense the matching quality depends on the variables used to estimate the probability of selection into the program. These variables should be determinant of the program participation and orthogonal to its result (Heckman *et al*., 1998). A way of calibrating matching quality is to analyze the distribution of the observable attributes between treated and non treated groups.

In the empirical approach adopted in this work we utilize as main explanatory variables of the participation in the program those appertaining to socioeconomic conditions and homicide rates in five semesters prior to the beginning of *Fica Vivo*. These variables are good proxies to treatment criteria. Treated slums were selected because they had been identified as risky areas in which were verified social vulnerability and high homicide rates. Social vulnerability variables refer to the year 2000, prior to the beginning of the program.

In order to control the bias on non-observable attributes we utilize the method of double differences applied to the set of units selected in the matching. This estimation is carried out considering fixed effects at the level of weighting areas. Under the hypothesis that non-observed differences in the average output between treated and non-treated not vary along time, the DD completely controls the bias of the non-observables (Bertrand *et al.*, 2004).

3.2.1. THE MATCHING

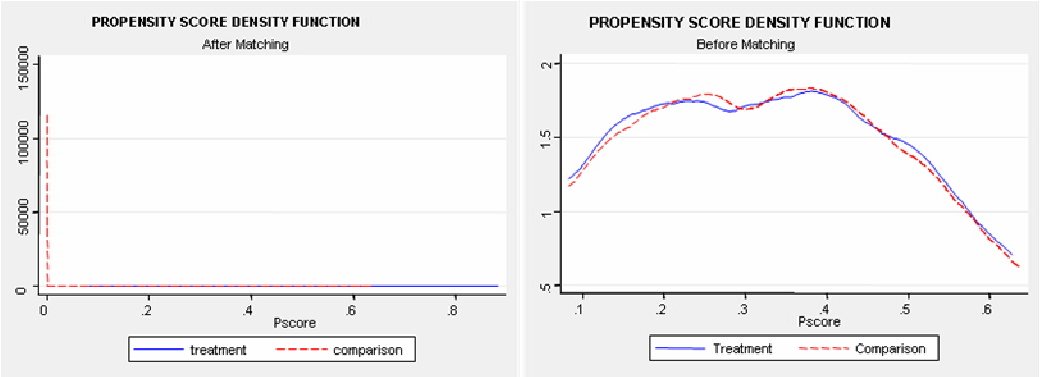
To estimate the probability of participation in the program we used a Probit model, where the dependent variable is a dummy that indicates if the census sector belongs to the pilot area. The model is well adjusted and presents a *pseudo* R^2 above 66%. Socio-economic variables behave as expected: the higher the socio-economic level, the less the probability of participation. The income dummies are the variables that best capture this conditionality, the higher the average income group of the census sector the less the probability of participation in the *Fica Vivo*[9] program. Homicide rates present positive coefficients meaning that census sectors with higher homicide rate before the intervention have higher probability of participation.

Figure 2 contains the graphs of propensity score density function for treatment and comparison groups. We use Nearest Neighbor Matching Method (NNM)[10]. After the matching, the propensity score distribution is nearly juxtaposed between treatment and comparison groups.

[9] The results of the Probit model are presented in the table B in the statistical appendix that can be requested from the authors.

[10] The results are very similar when we consider other matching techniques. The results can be requested from the authors.

Figure N° 2
PROPENSITY SCORE DENSITY FUNCTION FOR TREATMENT AND COMPARISON GROUPS



Tables 1 and 2 present the difference of treatment and comparison groups' covariate averages, before and after matching. After the matching almost no difference is observed between both groups showing that there is no bias on the observables variables.

Table N° 1
COVARIATE AVERAGES BEFORE AND AFTER MATCHING BY TREATMENT AND COMPARISON GROUPS

Variable	Before Matching			Average difference after Matching
	Trat. average	Comp. avarege.	Dif-Average	
Txhoms1	26.031	7.647	18,384***	-0.776
Txhoms2	35.745	9.418	26,327***	-41.939
Txhoms3	56.377	9.293	47,084***	-18.459
Txhoms4	35.828	8.268	27,560***	-2.671
Txhoms5	47.691	11.137	36,554***	-34.087
P_1banho	0.804	0.602	0,202***	-0.021
P_2banho	0.083	0.210	-0,127***	0.009
P_3banho	0.038	0.129	-0,091**	0.013
P_4mbanho	0.014	0.039	-0.025	-0.004
P_lixo	0.941	0.984	-0,044***	-0.018
P_homem	0.481	0.470	0,011**	-0.001
p_09aa	0.211	0.152	0,059***	0.001
p_1014aa	0.104	0.082	0,021***	-0.002
p_1519aa	0.115	0.097	0,017***	-0.006
p_2024aa	0.118	0.103	0,015***	0.002
p_2529aa	0.082	0.088	-0,007*	-0.004
p_30maa	0.371	0.477	-0,105***	0.010
P_rend0	0.112	0.069	0,043***	0.007
P_rend_1	0.252	0.112	0,140***	0.000
P_rend1_3	0.438	0.268	0,170***	-0.022
P_rend3_5	0.100	0.148	-0,048***	-0.009
P_rend5_10	0.047	0.188	-0,141***	0.010
Population in the semester 1	781.190	879.410	-98,220*	5.180
Population in the semester 2	789.610	878.200	-88.590	6.280
Population in the semester 3	798.110	877.460	-79.350	7.380
Population in the semester 4	807.270	887.250	-79.980	8.140
Population in the semester 5	816.540	898.440	-81.900	8.890

Note: *** est. significant at 1%, ** est. significant at 5%, * est. significant at 10%.

3.2.2. SPECIFICATION OF THE ESTIMATED MODEL

In order to estimate the impact of the program we estimated a Double Difference model taking into account its effect at two moments in time. This specification allowed to

estimate the impact of the program for the years 2004 to 2006 for which we have available cost data. Three time dummies were created and included in the model specification. The first variable (Time0) comprises the time before the start of the program – the first semester of 2000 till the first semester of 2002. The second dummy variable concerns the time from the second semester of 2002 till the second semester of 2003. During this time the program was set up in *Morro das Pedras* (Time1). Finally, the third time variable concerns the period from 2004 till 2006 - Time2.
Equation (1) describes the estimated specification:

$$H_{it} = \alpha + DD_1.MP_i*Time1 + DD_2 MP_i* Time2 + \gamma MP_i + \delta_1 Time1 + \delta_2 Time2 + \varepsilon_i \quad (1)$$

Where: H_{it} is the homicide rate per one hundred thousand inhabitants in census sector i and semester t;

MP_i is the dummy for the i census sectors belonging to the *Morro das Pedras*;

ε_i is the error term;

From this specification we obtain the effect of the program in *Morro das Pedras* in two moments of time. The coefficients DD_1 and DD_2 indicates the average effect of the treatment on the census sectors of the pilot area in time 1 and time 2 in relation to the comparison group. To conduct the economic evaluation we will only consider the program effects in the second time (2004 till 2006) because we do not have available cost data for the first time. In addition to the average effect of the treatment on the treated, we also obtain the effect under non-observables and the time effect. The effect under non-observables concerns the non-observed differences between the treated and the controls. It is given by the coefficient of the treatment variable - γ. The time effect indicates the variation in the homicide rate that occurs due to the inertia of the phenomenon, that is, due to the tendency. This effect is detected by the time dummy coefficients- δ_1 and δ_2.

The estimation of the above model by Ordinary Least Squares in the piled data indicated the presence of residuals´ correlation. In order to take it into account we performed the method of Generalized Least Squares. The Hausman Test pointed out that the most adequate specification for residuals´ correlation correction is a panel model with random effect (Wooldrigde, 2001). We estimate the model by this method including dummies for each weighting area in order to also consider a fixed effect at the weighting area level. This allows us to consider both an effect under non-observables not varying with time detected through the dummies of the weighting area, as well as an effect under non-observables random by census sector. The standard errors are estimated by cluster to correct residuals´ autocorrelation in accordance with Duflo (2001)[11]. The cluster option was performed considering both correlations at slum and weighting area levels. In order to do that, we built a new variable called weighting area 2 (AP2). This variable associates each census sector to its respective slum, in case that it is placed in a slum, or to its respective weighting area, if the census sector is not placed in a slum.

[11] We also estimated the model considering the simulation that the program started before the real date of its implementation. We do this in order to test if there were any other factor that should be altering the homicide rate in treated areas. Our assumption is that if before the program set up in Belo Horizonte city there were already differences between treated and non-treated areas regarding homicide rates we could not interpret the change in homicide rate after 2002 as determined by the program. See table F in the statistical appendix that can be requested from the authors.

3.3. IMPACT OF *FICA VIVO* PROGRAM

Table 2 presents the results of the estimated models. The coefficients presented show the differentials in the half-yearly homicide growth rate per one hundred thousand inhabitants for each time. As previously mentioned, the result of interest for the economic evaluation is the coefficient of interaction between the treatment dummy (MP) and the dummy of the second period of analysis (Time*2*). Cost information is only available to this period. We see that in this time *Fica Vivo* is responsible for a reduction of approximately 11 homicides per one hundred thousand inhabitants in the MP, per semester in relation to the comparison areas[12].

Table N^o 2
RESULTS OF DDM MODEL

Variable	Coefficient
Constant	73,59***
MP	-33,25***
Time1	-1.92
Time2	0.39
MP*Time1	-1.88
MP*Time2	-10,72**
Statistic	
sigma_u	25.69
sigma_e	67.47
rho	0.13
N. obs.	1418
N. obs per group - min	9
N.obs per group - avg	14.6
N. obs per group - max	28
Wald chi2	6.33
R-sq within	0.0014
R-sq between	0.4976
R-sq overall	0.1131

Note:(1) *** est. significant at 1%, ** est. significant at 5%, * est. significant at 10%.

(2) The full model is in the appendix

(3) GLS with random effect at average areas and cluster oprion for stardard erros.

To carry out the economic evaluation, it is necessary to calculate how many homicides were avoided by the program in *Morro das Pedras* (H), from 2004 to 2006. This calculation is realized, considering the effect of the program, given by the coefficient estimated in the model above and the population benefited. The number of homicides avoided each semester is given by (H_n):

$$H_n = (DD_2 * POP_n)/(100.000)$$

Where DD_2 is the average effect of the treatment on the treated, given by the coefficient of interaction between the treatment dummy and the second time of analysis (Time2) and

[12] In order to test possible spillover effect of the program, we estimated the model considering as areas treated the first order neighbors. The results show that the program has a positive impact also in the neighboring areas and that there was no increase in the criminality in areas surrounding the program. The results can be obtained with the authors.

POP_n is the population of the MP in each semester *n*. The total number of extra homicides avoided by the program in *Morro das Pedras* relative to comparison areas is given by the sum of the number of homicides avoided each semester.
Table 3 shows the population and the number of homicides avoided per semester between 2004 and 2006. The results indicate that 15 homicides were avoided in *Morro das Pedras*, between 2004 and 2006, in relation to the standard policy of public security, applied in the comparison group[13].

Table Nº 3
NUMBER OF HOMICIDES AVOIDED PER SEMESTER BETWEEN 2004 AND 2006

Semester	Population	Number of Homicides Avoided
Semester 1/2004	22869	2,45
Semester 2/2004	23151	2,48
Semester 1/2005	23435	2,51
Semester 2/2005	23754	2,55
Semester 1/2006	24076	2,58
Semester 2/2006	24382	2,61
Total		***15,18***

4. FICA VIVO COSTS

In this section we present the methodology applied for measuring the costs of the program at *Morro das Pedras* slum. We classify the costs of the *Fica Vivo* into three categories, costs of setting up, costs of social protection actions and costs of police actions. The costs of setting up and of social protection actions are under the responsibility of the State Secretariat of Social Defense (SEDS)[14]. Computation of SEDS expenditure is based on the accounting records of payment of services and goods for the *Fica Vivo*.

The expenditure of the police actions is accomplished in partnership by SEDS, Military and Civil Polices and Judicial System. In this paper the estimation of police actions costs includes only the cost of repressive and community policing, due to the unavailability of information of other institutions involved in the Program. The Judicial System should increase efficiency in the resolution of criminal procedures related to crimes that occurred at *Fica Vivo* areas. These actions include, for example, agility in search and arrest of criminals as well as in the judgment of local traffickers and homicides. These costs related to judicial actions are difficult to account, mainly because there were no specific instruments created for the program. Even though our cost information is underestimated and do not represent the totality of costs involved in the program, the actions developed by the Judicial System do not represent direct costs for the program.

[13] We call the standard policy of public security the policy of security adopted in general in the whole *Belo Horizonte* city.
[14] Information on costs was made available by the Superintendence of the Prevention of Criminality of the State Secretariat for Social Defense.

The computation of the cost of repressive and community policing included the resources transferred from SEDS to Civil and Military Polices and the estimation of wages of military police directly involved in the Program.

Table 4 sums up the *Fica Vivo* costs. It presents monetary values in dollars of 2006 and its distribution among the three categories of expense. Police action is the component of greatest cost within the program, consuming slightly more than 50% of the resources, followed by the social protection actions, which account for around 45%. The evolution of the disbursements over time is quite stable, only registering a fall in setting up expenditures during 2006, which reflects a reduction in the expansion of the program for other areas.

Table N^{o} 4
ABSOLUTE VALUE AND ITS COMPOSITION OF THE COST OF *FICA VIVO*

Category	2004		2005		2006	
	$	%	$	%	$	%
Costs of Setting Up	279,329	12	564,001	14	385,627	5
Costs of Social Protection Actions	714,470	31	1,759,231	44	3,792,335	45
Costs of Police Actions	1,292,175	57	1,670,705	42	4,324,332	51
Total Cost of Fica Vivo	**2,285,974**	**100**	**3,993,936**	**100**	**8,502,293**	**100**

Note: Dollar (US$) at 2006.

4.1. COSTS OF *FICA VIVO* IN *MORRO DAS PEDRAS*

One difficulty to estimate the costs of the program is that our accounting registers were not discriminated by area or slum. In order to calculate the cost of the program specifically in *Morro das Pedras* slum, we applied the methodology of apportionment so as to distribute the global cost between the areas in which the program was set up. The apportionment is done separately for each of the above-mentioned cost categories.

The calculation of setting up costs by area is carried out by the apportionment of the total setting up cost by year between the areas where the program was set up in each year. Our assumption is that the cost of setting up is uniform between the areas. Besides that we have also arbitrated a rate of depreciation of 10% per year to obtain the annual cost of these inputs as setting up expenditure is mainly related to the bought of fixed inputs.

The activities of social protection cover various aspects such as communication and social mobilization in relation to violence, social support and the constitution of protection networks. With the development of the program, these actions took on large dimensions in the program. In relation to the cost of social protection actions, we considered three criteria of apportionment: 1) proportion of direct beneficiaries of the social support actions who are the young people in regular attendance; 2) proportion of workshops performed for direct beneficiaries, which is the principal instrument of these actions; 3) number of areas/year[15]. To perform the economic evaluation the three forms of apportionment were considered.

Finally, related to the calculation of police actions costs, some information is discriminated by area/slum and some is not. The information related to police wages is discriminated by

[15] The measurement area/year is equivalent to the proportion of months in the year during which the area treated received the program.

area and SEDS transferences are not. In this case, the apportionment is calculated taking into account the proportion of policemen allocated to *Morro das Pedras* in each year.
Tables 5, 6 and 7 present, respectively, the calculation of the costs of the *Fica Vivo* program in *Morro das Pedras*, in accordance with the three forms of apportionment utilized to social protection actions.

Table N° 5
COSTS OF THE *FICA VIVO* PROGRAM IN *MORRO DAS PEDRAS* – APPORTIONMENT OF THE SOCIAL PROTECTION ACTIONS FOR THE PROPORTIONAL OF DIRECT BENEFICIARIES OF THE PROGRAM

Categoria	2004	2005	2006	*Total*
1. Costs of Setting Up	6,828	6,828	6,828	***20,483***
2. Costs of Social Protection Actions	328,473	332,399	398,229	***1,059,102***
3. Costs of Police Actions				
3.1.Transfers from the SEDS to police	131,166	13,292	52,256	***196,715***
3.2. Wages of military police directly involved in the Program	151,973	142,295	136,663	***430,931***
Total	***618,440***	***494,814***	***593,976***	***1,707,230***

Note: dollar (US$) at 2006

Table N° 6
COSTS OF THE *FICA VIVO* PROGRAM IN *MORRO DAS PEDRAS* – APPORTIONMENT OF THE SOCIAL PROTECTION ACTIONS PROPORTION OF WORKSHOPS PERFORMED FOR DIRECT BENEFICIARIES

Categoria	2004	2005	2006	*Total*
1. Costs of Setting Up	6,828	6,828	6,828	***20,483***
2. Costs of Social Protection Actions	246,334	280,231	261,784	***788,350***
3. Costs of Police Actions				
3.1.Transfers from the SEDS to police	131,166	13,292	52,256	***196,715***
3.2. Wages of military police directly involved in the Program	151,973	142,295	136,663	***430,931***
Total	***536,300***	***442,646***	***457,531***	***1,436,478***

Note: dollar (US$) at 2006

Table N° 7
COSTS OF THE *FICA VIVO* PROGRAM IN *MORRO DAS PEDRAS* – APPORTIONMENT OF THE SOCIAL PROTECTION ACTIONS BY THE NUMBER OF AREAS/YEAR

Categoria	2004	2005	2006	*Total*
1. Costs of Setting Up	6,828	6,828	6,828	***20,483***
2. Costs of Social Protection Actions	306,201	229,465	221,990	***757,656***
3. Costs of Police Actions				
3.1.Transfers from the SEDS to police	131,166	13,292	52,256	***196,715***
3.2. Wages of military police directly involved in the Program	151,973	142,295	136,663	***430,931***
Total	***596,168***	***391,879***	***417,737***	***1,405,785***

Note: dollar (US$) at 2006

5. RESULTS OF THE ECONOMIC EVALUATION

Table 8 presents the cost-effectiveness ratio, calculated as the ratio between the number of homicides avoided and the total of costs in the *Morro das Pedras*. The cost-effectiveness ratio is presented according to the three forms of apportionment social protection actions. The cost-effectiveness ratio gives the estimate of the cost of a homicide avoided by the program. The results show that the cost of a homicide avoided by the *Fica Vivo* varies between 93 thousand and 112 thousand dollars, depending on the method of apportionment of the cost.

Table N° 8
COST-EFFECTIVENESS RATIO OF THE *FICA VIVO* PROGRAM IN *MORRO DAS PEDRAS*, BETWEEN 2004 AND 2006

Apportionment Methodology	Cost-Effectiveness Ration
Proportional of direct beneficiaries of the workshops	112,434
Proportional of Workshops	94,603
Number of Areas/Year	92,582

Note: dollar (US$) at 2006

Another way of interpreting the results is to analyze the program in terms of how much money society would save due to the homicides which no longer occur. To make this estimation is necessary to know the value of the loss which the homicide imposes on society. This value is composed of, in addition to the value of the life, several other factors. In the literature on criminality many components are cited as expenditures with the Judicial System, expenditures with the Police apparatus, medical expenses with the violence and their respective family, insurance expenditures, among others are pointed out (Dubourg *et al.*, 2005; Brand and Price, 2000; Mayhew, 2003).

The most usual way of measuring the value of the life is through the calculation of production lost due to death. Lost production is an estimation of the flow of future income that the individual would have gained if he or she had not died. In Brazil, some works have

already done this calculation. We identified three: Iser (1998), Rondon and Andrade (2003), Carvalho *et al*. (2008) [16]. Table 9 sums up the values found in each work. According to these works, the value of the life varies between 72 and 270 thousand dollars in accordance with the methodology of estimation and the geographical unit considered. If we consider as a benefit of the program only the value of the life saved by the prevention of the homicide, the cost-benefit relationship is favorable when the parameters calculated by Iser (1998) and Rondon and Andrade (2003) are used.

Table N° 9
VALUE OF LOST OUTPUT COST HOMICIDE IN BRAZIL

Paper	Geografic area	Lost output cost for homicide - Dollar (US$) at 2006.
ISER (1998)	*Rio de Janeiro* city	133,049
Rondon e Andrade (2003)	*Belo Horizonte* city/MG - methodology 1	270,430
	Belo Horizonte city/ MG - methodology 2	207,502
Carvalho et al. (2007)	Brazil, 2000	89,994
	Minas Gerais State, 2000	71,711
	Brazil, 2001	88,271
	Minas Gerais State, 2001	75,215

Note: Thetable D on the appendix presents the original costs of the papers with por details and the convertion for the monetary values at 2006.

In Brazil there are no works that estimates the total value of loss due to homicides. In order to calculate the total value of the loss generated by the homicide, we used the parameters existing in the international literature referring to the relative participation of the value of the life in the total value of the loss generated by the homicide to society[17]. Table 10 presents many papers found in the international literature that estimate the losses incurred by the homicide. For each paper the proportion of each component in the cost of the homicide to society is presented. The relative participation varies from 31% to 74%, depending on the components included.

[16] In addition to these works, we must mention Soares (2006) which estimates the costs of violence to social well-being. The author utilizes the approach of propensity to pay to measure the monetary value of the reductions in the probability of survival for individuals of a determined age. Starting from the table of survival and of the age distribution of the population of each country, the author calculates the social cost of violence considering the current population and future generations.

[17] In the work of Rondon and Andrade (2003) the authors calculate the costs of criminality considering other categories of crime.

Table N° 10
PROPORTION OF EACH COMPONENT IN THE COST OF THE HOMICIDE TO SOCIETY

Paper	Component	Proportion of each component in the cost of the homicide for the society (%)
Brand e Price (2000) United Kingdon	Physical and emotional impact	63.79
	Victim services	0.43
	Lost output	***33.72***
	Health services	0.06
	Police activity	1.00
	Prosecution	0.04
	Magistrates courts	0.01
	Crown court	0.07
	Jury sevice	0.01
	legal aid	0.10
	Non legal-aid defence	0.02
	Probation service	0.04
	Prision service	0.38
	Other CJS costs	0.15
	Criminal injuries compensation admin	0.18
Dubourg e Hamed (2005) United Kingdon	Physical and emotional impact	68.88
	Lost output	***31.12***
Mayhew (2003) Australia	Health services	0.47
	Lost output	***74.65***
	Intangible cost	24.88

Note: Thetable D on the appendix presents the original costs of the papers with por details and the convertion for the monetary values at 2006.

In the calculation of the value of the total loss caused by one homicide in Brazil we used parameters available in the empirical Brazilian literature and also in the international literature. The value of the life (Table 9) is parameterized by empirical works in Brazil and the relative participation of the value of the life in the total value of the loss generated by the homicide is parameterized by works in the international literature (Table 10). The cost-benefit ratio is calculated utilizing the total loss generated by the homicide for Brazil and the cost of the reduction of one homicide in the Program.

In order to test the sensitivity of the results, we performed a sensitivity analysis varying the values of the parameters: relative participation of the cost of the life in the total cost of the homicide. We have also considered the three forms of cost apportionment.

Table 11 shows the least and largest cost-benefit ratio estimated for each method of apportionment and all combination of parameters. In general the program is cost effective varying from a small return tax, approximately 4%, to large return tax, around 840%. Only in two combinations of parameters the *Fica Vivo* is not cost-effective, that is, does not present a return for society[18].

[18] Table F of the annex presents all the cost-benefit ratios calculated. Of the 63 cost-benefit ratios calculated for the combinations only 2 are not cost-effective: combinations of the cost of the years of production lost due to homicide for *Minas Gerais*, in 2000 and 2001, (Carvalho *et. al*, 2007), the proportion that this cost represents in the total loss which homicide causes society calculated by Mayhew (2003) and the method of apportionment by the proportion of young people in regular attendance.

Table N° 11
COST-BENEFIT RATIO FOR THE FICA VIVO IN MORRO DAS PEDRAS, BETWEEN 2004 AND 2006

Apportionment Methodology	Cost-Benefit Ratio	
	Least	Largest
Proportional of direct beneficiaries of the program	0.85	7.73
Proportional of Workshops	1.02	9.19
Number of Areas/Year	1.04	9.39

6. FINAL CONSIDERATIONS

In this work we carried out an impact evaluation of *Fica Vivo* program. *Fica Vivo* is the important program of prevention and control of criminality that is being carried in Brazil. This paper contributes as this type of evaluation is quite scanty both in economic and criminological literature. Besides that Latin America presents high levels of criminality and the welfare loss associated, mainly due to high levels of homicide rate is quite important. Public policy programs should be evaluated in order to allow the better resource allocation. Even though the program design was not randomized we could identify similar areas and took advantageous of having a longitudinal data that allowed us to control for specific characteristics. In addition, the evaluation method uses administrative data from police records which makes it possible its replication in other countries.

The principal objective of the program is the reduction of homicides in areas of hot spots. Regarding homicides, in general, in Brazil, these hot spots occur in slums. The program combines preventive with repressive (police/ judicial) activities. The impact of the program is estimated using a DDM method applied to a panel data of police records between 2000 and 2006. In this analysis we focus on the pilot area when the program was set up first, Called *Morro das Pedras* slum. The impact variable is the half-yearly homicide rate per one hundred thousand inhabitants.

The *Fica Vivo* cost was carried out through the analysis of all the accounting records of the program between 2004 and 2006 made available by the management and executive staffs. In the economic evaluation we utilize the frameworks of the methodologies of cost-effectiveness and cost-benefit.

The results show that between 2004 and 2006 the program reduces 10.72 homicides per one hundred thousand inhabitants per semester less in pilot area in relation to the areas of comparison. This is equivalent to the prevention of approximately 15 homicides in the pilot in three years. The cost of a homicide avoided by the *Fica Vivo* varies between approximately 93 and 112 thousand dollars in accordance with the method of apportionment. In this analysis we do not include other possible effects of the program because of the unavailability of information, so that the results of the program may be being underestimated. The rate of return of the program is favorable for practically all parameters utilized, varying from a small return tax, 4%, to a large return tax, 840%. These results suggest that the *Fica Vivo* present a favorable cost-benefit ratio.

An extension of this work concerns the utilization of the total value of the social loss generated by homicide in Brazil instead of international parameters. For this extension the estimation of the total value of the social loss is necessary, as accurate estimates of these data do not exist for Brazil. In the present work this lacuna is minimized in part through the analysis of the sensitivity of the parameters.

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STATISTICAL APPENDIX

TABLE A
SOCIAL AND ECONOMIC VARIABLE INCLUDED IN THE PROBIT MODEL

Variable
p_1resid: *proportion of household with one resident.*
p_2resid: *proportion of household with two residents.*
p_3resid: *proportion of household with three residents.*
p_4resid: *proportion of household with four residents.*
p_5resid: *proportion of household with five residents.*
p_6mresid: *proportion of household with six or more residents.*
p_casa: *proportion of houses .*
p_apart: *proportion of apartament.*
P_comodo: *proportion of one room.*
p_agua: *proportion of household with water supply.*
p_esgoto: *proportion of household with sewage.*
p_banho: *proportion of household with bathroom.*
P_banho0: *proportion of household without bathroom.*
p_banho1: *proportion of household with one bathroom.*
p_banho2: *proportion of household with two bathrooms.*
p_banho3: *proportion of household with three bathrooms.*
p_banho4m: *proportion of household with four or more bathrooms.*
p_lixo: *proportion of household with garbage public service .*
p_alfab: *proportion of literates.*
p_alfab15_29: *proportion of literates with 15 to 29 years old.*
p_homem: *proportion of mem.*
p_09aa: *proportion of individuals with 0 to 9 years old .*
p_1014aa: *proportion of individuals with 10 to 14 years old.*
p_1519aa: *proportion of individuals with 15 to 19 years old.*
p_2024aa: *proportion of individuals with 20 to 24 years old.*
p_2529aa: *proportion of individuals with 25 to 29 years old.*
p_30maa: *proportion of individuals with 30 years old or more.*
P_resp1019aa: *proportion of households head with 10 to 19 years old*
P_resp2019aa: *proportion of households head with 20 to 29 years old*
P_resp30maa: *proportion of households head with 30 years old or more.*
P_respalfab: *proportion of literate households head.*
P_resp_estudo0_1: *proporton of household head with 0 to 1 years of schooling.*
P_resp_estudo1_4: *proportion of households head with 1 to 4 schooling.*
P_resp_estudo5_8: *proportion of households head with 5 to 8 schooling.*
P_resp_estudo9_11: *proportion of households head with 9 to 11 schooling.*
P_resp_estudo12m: *proportion of households head with 12 schooling or more.*
p_rend0: *proportion of no-income households head .*
p_rend_1: *proportion of household head with less than one minimum wage.*
p_rend1_3: *proportion of households head with 1 to 3 minimum wage.*
p_rend3_5: *proportion of households head with 3 to 5 minimum wage.*
p_rend5_10: *proportion of households head with 5 to 10 minimum wage.*
p_rend10m: *proportion of households head with 10 or more minimum wage.*

Note: (1) All proportion variables refer to census sector

TABLE N^{O} B
PROBIT MODEL RESULTS

Variable	Coef.
Constant	-11.18
Txhoms1	0.0025
Txhoms2	0,0035*
Txhoms3	0,0041**
Txhoms4	0.0035
Txhoms5	0.0026
P_1banho	1.48
P_2banho	-4.82
P_3banho	0.23
P_4mbanho	-0.5
P_lixo	-0.12
P_homem	-9.21
P_09aa	18.88
P_1519aa	27,04*
P_2024aa	28,94*
P_2529aa	-9.68
P_30maa	16.16
P_rend0	-4.39
P_rend_1	2.03
P_rend1_3	-0.28
P_rend3_5	-2.32
P_rend5_10	-8.94
Population in the semester 1	-6,71***
Population in the semester 2	13,25***
Population in the semester 3	-8,55***
Population in the semester 4	3,90***
Population in the semester 5	-1,89***
Statistics	
Number of obs.	2542
LR chi2	192.27
Pseudo R-squared	0.66
Log likelihood	-48.88

Note: *** est. significant at 1%, ** est. significant at 5%, significant at 10%.

TABLE N^{O} C
RESULTS OF DDM MODEL FOR THE PROGRAM IMPACT IN *MORRO DAS PEDRAS*

Variable	Coeficient
Constant	73,59***
ap2_2	-38,72***
ap2_6	-45,27***
ap2_8	-20,35***
ap2_15	-15,23***
ap2_16	-73,35***
ap2_20	-69,81***
ap2_25	-61,93***
ap2_26	-41,59***
ap2_29	-2,90***
ap2_33	-73,35***
ap2_35	-38,49***
ap2_37	-73,35***
ap2_39	-62,27***
ap2_47	-29,74***
ap2_50	-63,45***
ap2_52	-73,35***
ap2_54	-3,22***
ap2_57	-22,77***
ap2_58	-73,35***
ap2_59	-51,76***
ap2_60	-45,92***
ap2_62	25,85***
ap2_64	-73,35***
ap2_75	-73,35***
ap2_500	-73,35***
ap2_800	-73,35***
ap2_1500	-53,62***
ap2_1800	-73,35***
ap2_1900	-18,22***
ap2_2700	-62,23***
ap2_3100	-61,52***
ap2_3300	-31,13***
ap2_3400	45,68***
ap2_3500	34,49***
ap2_3700	-10,10***
ap2_3900	0,63***
ap2_5100	-73,25***
ap2_5300	-14,44***
ap2_5600	-46,65***
ap2_5700	-49,65***
ap2_6000	-52,44***
MP	-33,25***
Time1	-1.92
Time2	0.39
MP*Time1	-1.88
MP*Time2	-10,72**
Statistic	
sigma_u	25.69
sigma_e	67.47
rho	0.13
N. obs.	1418
N. obs per group - min	9
N.obs per group - avg	14.6
N. obs per group - max	28
Wald chi2	6.33
R-sq within	0.0014
R-sq between	0.4976
R-sq overall	0.1131

Note:1) *** est. significant at 1%, ** est. significant at 5%, * est. signifi

TABLE N^{O} E
HOMICIDE COST CONVERTED AT 2006 CURRENCY VALUE

(continue)

Paper / country	Cost estimeted per incident in paper	Date of currency value reference	Inflation rate until December, 2006	2006 average exchange rate Taxa (£/ US$)	2006 currency value in US$
Brand e Price (2000) United Kingdon	Average cost estimeted for homicide -£1.100.000	1999	0.1183	1.84	2,267,276
	Physical and emotional impact - £700.000				1,442,812
	Victim services -£ 4.700				9,687
	Lost output -£ 370.000				762,629
	Health services -£ 630				1,299
	Police activity -£ 11.000				22,673
	Prosecution -£ 410				845
	Magistrates courts -£ 100				206
	Crown court -£ 720				1,484
	Jury sevice -£ 90				186
	legal aid-£ 1.100				2,267
	Non legal-aid defence -£ 205				423
	Probation service - £ 430				886
	Prision service - £4.200				8,657
	Other CJS costs - £ 1.700				3,504
	Criminal injuries compensation admin -£ 2.000				4,122
Dubourg e Hamed (2005) United Kingdon	Average cost estimeted for homicide - £1.458.957	2003	0.0667	1.84	2,868,352
	Physical and emotional impact - £998.500				1,963,080
	Lost output -£ 451.100				886,876
Mayhew (2003) Australia	Average cost estimeted for homicide – U$1.600.000	2001	0.1432		1,829,087
	Medical cost - U$7.600				8,688
	Lost output – U$1.200.000				1,371,815
	Intangible cost - U$400.000				457,272

Note: The currency values were nflationated by the original country oficial inflation rate and then they were converted at the 2006 average exchange rate ($/US$).

TABLE N^{O} E
HOMICIDE COST CONVERTED AT 2006 CURRENCY VALUE

(End)

Paper / country	Cost estimeted per incident in paper	Date of currency value reference	Inflation rate until December, 2006	2006 average exchange rate Taxa (£/ US$)	2006 currency value in US$
ISER (1998) Brazil	Lost output -R$ 137.718,03	1995	1.1017	0.46	133,049
Rondon e Andrade (2003) Brazil	Lost Output: metodologia 1 - R$ 357.384,98	1999	0.6462	0.46	270,430
	metodologia 2 - R$ 274.222,59				207,502
Carvalho et al. (2007) Brazil	Lost output: Brazil, 2000 - R$ 193.200,00	Aug-06	0.0134	0.46	89,994
	Minas Gerais Stated, 2000 - R$153.950,00				71,711
	Brazil, 2001 - R$ 189.500,00				88,271
	Minas Gerais Stated, 2001 - R$161.472,30				75,215

Note: The currency values were nflationated by the original country oficial inflation rate and then they were converted at the 2006 average exchange rate ($/US$).

TABLE N^{O} F
SENSITIVITY ANALYSIS - COST-BENEFIT RATIO ESTIMATED FOR EACH METHOD OF APPORTIONMENT AND ALL COMBINATION OF PARAMETERS

Apportionment Methodology	Paper about homicide cost and its components	Papers about loss production because homicide	Geografic area	Lost output cost per incident (US$ 2006)	Homicide cost estimated per incident in Brazil (US$ 2006)	Cost-benefit ratio
Proportional of direct beneficiaries of the program	Brand e Price (2000) United Kingdon	ISER (1998)	*Rio de Janeiro* city	133,061	394,611	3.51
		Rondon e Andrade (2003)	*Belo Horizonte* city/MG - methodology 1	270,454	802,068	7.13
			Belo Horizonte city/MG - methodology 2	207,520	615,429	5.47
		Carvalho et al. (2007)	Brazil, 2000	90,002	266,913	2.37
			Minas Gerais State, 2000	71,717	212,688	1.89
			Brazil, 2001	88,278	261,801	2.33
			Minas Gerais State, 2001	75,222	223,080	1.98
	Dubourg e Hamed (2005) United Kingdon	ISER (1998)	*Rio de Janeiro* city	133,061	427,589	3.80
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	869,098	7.73
			Belo Horizonte city/MG - methodology 2	207,520	666,862	5.93
		Carvalho et al. (2007)	Brazil, 2000	90,002	289,220	2.57
			Minas Gerais State, 2000	71,717	230,462	2.05
			Brazil, 2001	88,278	283,681	2.52
			Minas Gerais State, 2001	75,222	241,723	2.15
	Mayhew (2003) Australia	ISER (1998)	*Rio de Janeiro* city	133,061	178,257	1.59
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	362,318	3.22
			Belo Horizonte city/MG - methodology 2	207,520	278,008	2.47
		Carvalho et al. (2007)	Brazil, 2000	90,002	120,573	1.07
			Minas Gerais State, 2000	71,717	96,077	0.85
			Brazil, 2001	88,278	118,264	1.05
			Minas Gerais State, 2001	75,222	100,772	0.90
Proportional of Workshops	Brand e Price (2000) United Kingdon	ISER (1998)	*Rio de Janeiro* city	133,061	394,611	3.51
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	802,068	8.48
			Belo Horizonte city/MG - methodology 2	207,520	615,429	6.51
		Carvalho et al. (2007)	Brazil, 2000	90,002	266,913	2.82
			Minas Gerais State, 2000	71,717	212,688	2.25
			Brazil, 2001	88,278	261,801	2.77
			Minas Gerais State, 2001	75,222	223,080	2.36
	Dubourg e Hamed (2005) United Kingdon	ISER (1998)	*Rio de Janeiro* city	133,061	427,589	4.52
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	869,098	9.19
			Belo Horizonte city/MG - methodology 2	207,520	666,862	7.05
		Carvalho et al. (2007)	Brazil, 2000	90,002	289,220	3.06
			Minas Gerais State, 2000	71,717	230,462	2.44
			Brazil, 2001	88,278	283,681	3.00
			Minas Gerais State, 2001	75,222	241,723	2.56
	Mayhew (2003) Australia	ISER (1998)	*Rio de Janeiro* city	133,061	178,257	1.88
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	362,318	3.83
			Belo Horizonte city/MG - methodology 2	207,520	278,008	2.94
		Carvalho et al. (2007)	Brazil, 2000	90,002	120,573	1.27
			Minas Gerais State, 2000	71,717	96,077	1.02
			Brazil, 2001	88,278	118,264	1.25
			Minas Gerais State, 2001	75,222	100,772	1.07
Number of Areas/Year	Brand e Price (2000) United Kingdon	ISER (1998)	*Rio de Janeiro* city	133,061	394,611	1.92
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	802,068	8.66
			Belo Horizonte city/MG - methodology 2	207,520	615,429	6.65
		Carvalho et al. (2007)	Brazil, 2000	90,002	266,913	2.88
			Minas Gerais State, 2000	71,717	212,688	2.30
			Brazil, 2001	88,278	261,801	2.83
			Minas Gerais State, 2001	75,222	223,080	2.41
	Dubourg e Hamed (2005) United Kingdon	ISER (1998)	*Rio de Janeiro* city	133,061	427,589	4.62
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	869,098	9.39
			Belo Horizonte city/MG - methodology 2	207,520	666,862	7.20
		Carvalho et al. (2007)	Brazil, 2000	90,002	289,220	3.12
			Minas Gerais State, 2000	71,717	230,462	2.49
			Brazil, 2001	88,278	283,681	3.06
			Minas Gerais State, 2001	75,222	241,723	2.61
	Mayhew (2003) Australia	ISER (1998)	*Rio de Janeiro* city	133,061	178,257	1.93
		Rondon e Andrade	*Belo Horizonte* city/MG - methodology 1	270,454	362,318	3.91
			Belo Horizonte city/MG - methodology 2	207,520	278,008	3.00
		Carvalho et al. (2007)	Brazil, 2000	90,002	120,573	1.30
			Minas Gerais State, 2000	71,717	96,077	1.04
			Brazil, 2001	88,278	118,264	1.28
			Minas Gerais State, 2001	75,222	100,772	1.09